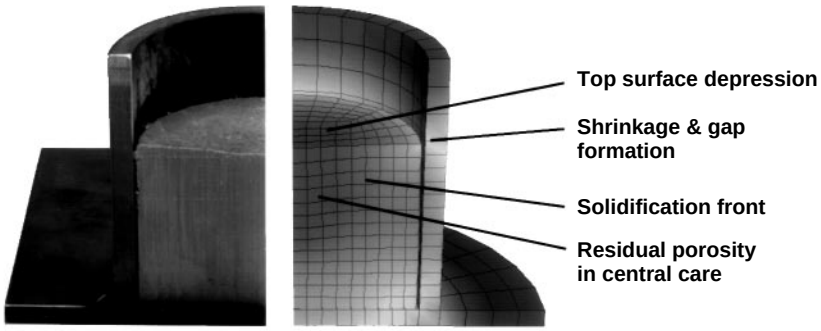
Casting Process Modeling

Casting R&D to enhance U.S. competitiveness by reducing costs and shortening design-to-market time

Competition to produce cast parts of higher quality, lower rejection rate, and lower cost is a fundamental factor in the global economy. To gain an edge on foreign competitors, the U.S. casting industry must cut manufacturing costs and reduce the time it takes to get a cast metal part from the design stage to the marketplace. The key: Pushing the state of the art of casting technology through research and development.



NITO calculations of a casting showing volume changes during solidification and cool down.

LLNL is home to a wide range of casting-process modeling projects that are doing just that. Projects include numerical simulation of fluid flow, heat transfer, solidification kinetics, and part distortion with residual stresses. We also have special facilities to cast toxic material, advanced measurement and instrumentation systems, and extensive experience in casting metals and nonmetals.

CAPABILITIES

- *Casting-process modeling, including numerical simulation of fluid flow, heat transfer, solidification kinetics, and part distortion with residual stresses*
- *Special facilities to cast toxic materials*
- *Extensive experience in casting metals and nonmetals*
- *Advanced measurement and instrumentation systems*

The DOE and LLNL are interested in casting research and development because we want to reduce the hazardous waste and scrap produced by DOE metal-component fabrication processes. Any new DOE facility manufacturing plutonium or uranium components will need a simplified process not only to minimize scrap metal, contaminated waste, and possible radiation exposure but also to reduce the cost of equipment and facilities. LLNL has been conducting both experimental and computer-model feasibility studies on precision die casting to produce near-net-shape components.

For casting process modeling, we use NITO, a three-dimensional, thermal-mechanical finite-element computer code. By correctly modeling the physics of volume change on solidification, shrinkage on cooling, and contact resistance across gaps, we can obtain accurate information on the cooling rate and thus predict the final shape, grain microstructure, defects, and stress state of the cast part.

Availability: This technology is available now. LLNL is seeking collaborative projects with industrial partners to combine our advanced casting expertise and technology with the partners' broader insights into casting industry issues, casting process data, and the collective experience of industry experts.

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